Chapter 6

Meteorological Algorithm Parameters

6.1 Introduction

Chapter 6 presents the default setting for each of the WSR-88D meteorological algorithm adaptable parameters.

Environmental-condition sensitive algorithm parameters (e.g. 0 and -20 degree Celsius heights, nominal clutter area, default storm motion, etc.,) should be routinely modified to improve algorithm performance.

CAUTION

Caution is warranted; modifications to some algorithm parameters may have a significant detrimental impact on the performance, accuracy, and reliability of the target algorithm and related products, as well as on RPG system performance.

Algorithm research activity ***MUST NOT*** be done on the WSR-88D system, but can be accomplished using Archive II data and the SOO/SAC workstations running the WATADS software package.

6.2 Environmental Data

6.2.1 Environmental Winds - Agency LOCA

The Environmental Winds Table is a list of wind speeds and directions at 1000 ft intervals from the surface to 70,000 ft MSL. The Velocity Dealiasing Algorithm uses information from the environmental winds table when there is no continuity available to dealias suspect velocity estimates. With the Auto VAD Update feature enabled, the wind speeds and directions are updated every volume scan by the Velocity Azimuth Display Task. Additionally, manual modification of this table is possible. The Environmental Winds Edit Screen is used to observe the current values being used by the algorithm, as well as to modify the values to ones that better reflect the ambient wind field.

Occasionally aliased velocity data is not handled well by the Velocity Dealiasing Algorithm. One possible cause may be that the current Environmental Winds Table does not accurately reflect the ambient wind field. When this occurs, use other reliable sources for upper air data and manually update the Environmental Winds Table and ensure the Auto VAD Update Function is enabled (on).

```
                         ENVIRONMENTAL WINDS EDIT SCREEN            PAGE  1 OF  5
COMMAND: E,E,
FEEDBACK:                                                            OPER A/

  (M)odify, {N}    (E)nd    (C)ancel    (A)uto Vad Update
  (U)nits Toggle {m/s vs kts}    (I)nitialize Table,{Start level, End level} *

         N    HGT(kft msl)     MEAN DIR (deg)   MEAN SPD(kts) Auto Update: ON
        ----------------------------------------------------


        ----------------------------------------------------
  N     HGT       MEAN DIR   MEAN SPD  |  N     HGT       MEAN DIR   MEAN SPD
---------------------------------------+-------------------------------------
  1     1.3       32767.0    32767.0      8     8.3       32767.0    32767.0
  2     2.3       32767.0    32767.0      9     9.3       32767.0    32767.0
  3     3.3       32767.0    32767.0     10    10.3       32767.0    32767.0
  4     4.3       32767.0    32767.0     11    11.3       32767.0    32767.0
  5     5.3       32767.0    32767.0     12    12.3       32767.0    32767.0
  6     6.3       32767.0    32767.0     13    13.3       32767.0    32767.0
  7     7.3       32767.0    32767.0     14    14.3       32767.0    32767.0
NOTE: Start level must be less than or equal to End level.  Only integer values
      are allowed for this command.
```

Figure 6.2-1

6.2.2 Hail Temperatures/Default Storm Motion - URC LOCA

The Hail Detection Algorithm predicts the probability of hail, severe hail and hail size by searching for high reflectivity values which exist above the freezing level. For this algorithm to provide the most accurate data, the radar operator must provide the altitude of the 0°C and -20°C isotherms, based on current sounding data.

The tracking and forecast algorithms assign the default storm motion to cells for the first volume scan that storm cells develop (i.e. the initial convection within the radar umbrella). Therefore, the **DEFAULT STORM SPEED** and **DIRECTION** should be changed ***before*** convection starts and should represent the expected motion of storm cells at the beginning of the event. After the first volume scan, the vector-average motion of all storm cells in the previous volume scan is assigned to new cells. If at the start of convection, the default storm motion is unrepresentative of the actual storm motion, the performance of the tracking and forecasting algorithms may initially be decreased. This could initially degrade the accuracy of cell trend data and storm relative velocity products. If storm cells have already been identified and tracked (for a volume scan), changing these parameters will have no effect until the next convective event.

```
                HAIL TEMPERATURES/DEFAULT STORM MOTION             PAGE  1 OF  1
COMMAND: E,H,
FEEDBACK:                                                           OPER A/

(M)odify        (E)nd        (C)ancel

ITEM              ALTITUDE MSL                DEFAULT STORM MOTION
               0 DEG C      -20 DEG C          DIRECTION      SPEED
------------------------------------------------------------------------------
CURRENT        10.5 Kft       20.0 Kft           270 Deg       10.0 Kts
------------------------------------------------------------------------------
MIN             0.0            0.0                0             0.0
MAX            70.0           70.0               360           99.9
```

Figure 6.2-2

6.3 Centroids of Components and Storms

The Storm Cell Centroids algorithm is the part of the Storm Cell Identification and Tracking (SCIT) algorithm which identifies storm cells and their components. The largest difference between the SCIT algorithm and the Storm Series algorithms is that instead of defining the volume of convective storms, this algorithm identifies the individual high reflectivity cores or cells within convective storms. The SCIT algorithm's ability to identify and track cells within a larger area of significant reflectivity (e.g. squall line) is significantly improved over the Storm Series (pre-Build 9.0) algorithm package. However, SCIT will still have difficulty identifying (and tracking) cells if a large area of significant reflectivity is nearly constant with no substantial reflectivity maximum, as in a uniform squall line or a stratiform area of moderate to heavy rain.

6.3.1 Overview of SCIT

First, to identify cells, the algorithm combines segments (from the Storm Cell Segments algorithm) into two-dimensional potential components. The segment must overlap radially by at least the **Threshold (Segment Overlap)** and be on adjacent radials which are less than the **Threshold (Az Separation)** apart. Since there are multiple reflectivity thresholds used to find segments, ***only segments found on the same elevation scan with the same reflectivity threshold are combined***. The **Threshold (Mx Pot Comp/Elev)** is the maximum number of potential components which can be saved per reflectivity threshold per elevation scan. The potential component is labeled a component if it has a minimum of at least the **Threshold (# Segment/Comp)** number of segments and has a minimum area of **Threshold (Component Area)** for its reflectivity threshold.

Next, a search is done for overlapping components of different reflectivity thresholds on the same elevation scan to identify centroids. A centroid is the mass-weighted center of a component or cell. If the centroid of a component found with a higher reflectivity threshold falls within the boundaries of another component, the component found with the higher reflectivity threshold is saved, and the other is discarded. After this process, the **Threshold (Max Comp/Elev)** value is the final number of components per elevation scan which can be saved.

Then the components are vertically correlated, i.e. assigned to the same cell. The centroids of the components at adjacent elevation scans are compared for horizontal proximity. For each component, the distance from the center of every component in the next highest elevation scan is compared until a component is found within a specified search radius, **Threshold (Search Radius #1)**. If no match is found for a component, then the search radius is increased to **Threshold (Search Radius #2)**, and the comparison is done again. This process is repeated if necessary with **Threshold (Search Radius #3)**. At this point, **Threshold (Max Detect Cells)** is the maximum number of cells saved (in a volume scan).

If two cells' centroids are within spacial proximity, the cells are merged. To merge two cells, their centroids must be within a specified horizontal distance, **Threshold (Horizontal Merge)**, and their bases and tops must be within a specified vertical and angular separation, **Threshold (Height Merge)** and **Threshold (Elevation Merge)**, respectively. When merging two cells, one cell's components are added to the other cell, and a new centroid is calculated. Next, to reduce the crowding, when two cells are still within spacial proximity, the cell with the lesser Cell-based VIL is deleted. To delete one of the cells, either of their centroids must be no more than **Threshold (Horizontal Delete)** apart. Or, the difference in their cell depths must be greater than the **Threshold (Depth Delete)** and their centroids must be no more than twice the **Threshold (Horizontal Delete)** apart. The final maximum number of cells (after the merging and deletion processes) in a volume scan is **Threshold (Max Cells/Vol)**.

6.3.2 Threshold Maximum VIL - URC LOCA

The **Threshold (Maximum VIL)** value is the maximum Cell-based VIL which will be computed or displayed. The Cell-based VIL is an estimate of the liquid water through a storm cell, based on the cell’s component’s maximum reflectivities. The purpose of the **Threshold (Maximum VIL)** is to mitigate hail contamination of the Cell-based VIL. However, since the Cell-based VIL can be used as a hail predictor, the default value is set at it’s maximum value. The value can be lowered to prevent extremely high Cell-based VILs due to hail contamination. For example, the threshold can be set equal to 80 kg/m^2, the same as the MVT - Max VIL Threshold in the VIL algorithm. ***This adaptable parameter only affects the Cell-based VIL***.

```
                              STORM CELL CENTROIDS                PAGE  1 OF  2
COMMAND: AD,*****,M,*****,CE,
FEEDBACK:                                                          OPER A/

(M)odify   (E)nd   (C)ancel

DESCRIPTION                               RANGE              VALUES    UNITS
--------------------------------------------------------------------------------
THRESH (# SEGMENTS/COMP)                 1 - 4                  2      -
THRESH (SEGMENT OVERLAP)                 0 - 5                  2      BINS
THRESH (AZ SEPARATION)                 1.5 - 3.5              1.5      DEG
THRESH (MX POT COMP/ELEV)               10 - 100               70      -
THRESH (MAX COMPS/ELEV)                 20 - 120              120      -
THRESH (MAX DETECT CELLS)               20 - 130              130      -
THRESH (MAX CELLS/VOL)                  20 - 100              100      -
THRESH (MAXIMUM VIL)                     1 - 120              120      KG/M**2
THRESH (COMPONENT AREA #1)            10.0 - 30.0            10.0      KM**2
       (COMPONENT AREA #2)            10.0 - 30.0            10.0      KM**2
       (COMPONENT AREA #3)            10.0 - 30.0            10.0      KM**2
       (COMPONENT AREA #4)            10.0 - 30.0            10.0      KM**2
       (COMPONENT AREA #5)            10.0 - 30.0            10.0      KM**2
```

Figure 6.3-1

```
                              STORM CELL CENTROIDS                PAGE  2 OF  2
COMMAND: AD,*****,M,*****,CE,
FEEDBACK:                                                          OPER A/

(M)odify   (E)nd   (C)ancel

DESCRIPTION                               RANGE              VALUES    UNITS
--------------------------------------------------------------------------------
THRESH (COMPONENT AREA #6)            10.0 - 30.0            10.0      KM**2
       (COMPONENT AREA #7)            10.0 - 30.0            10.0      KM**2
THRESH (SEARCH RADIUS #1)              1.0 - 10.0             5.0      KM
       (SEARCH RADIUS #2)              1.0 - 12.5             7.5      KM
       (SEARCH RADIUS #3)              1.0 - 15.0            10.0      KM
THRESH (DEPTH DELETE)                  0.0 - 10.0             4.0      KM
THRESH (HORIZONTAL DELETE)             3.0 - 30.0             5.0      KM
THRESH (ELEVATION MERGE)               1.0 - 5.0              3.0      DEG
THRESH (HEIGHT MERGE)                  1.0 - 8.0              4.0      KM
THRESH (HORIZONTAL MERGE)              5.0 - 20.0            10.0      KM
```

Figure 6.3-2

6.4 Combined Shear

The Combined Shear algorithm is intended to assist the user in identifying shear regions such as along gust fronts and in mesocyclones. It is especially useful in that, unlike the human operator, it isn't keying off color contrasts. The combined shear algorithm computes estimates of shear along a radial and also gate-to-gate tangentially between two radials. These two measures are mapped onto separate Cartesian grids whose resolutions are controlled by the domain resolution adaptable parameter, **DOR**. These two measures are combined by taking the square root of the sum of the squares of each estimate. The combined shear may be smoothed by applying an equally weighted two-dimensional filter to the gridded field. The filter is always centered on a grid point. Thus, it is required to have odd-numbered integer dimensions. The adaptable parameter **NFL** adjusts the size of the filter and is specified as the total number of points in the filter. For example, a value of 25 for **NFL** indicates that a 5 x 5 point filter is being used. Because this algorithm is CPU-intensive, the user is restricted to applying it to only one elevation at a time. The default elevation scan beginning with Build 9 is the 0.5 degree elevation scan. Each unique elevation angle is numbered sequentially from 1 to the highest number in the VCP. For VCP 21 the highest valid number is 9 and for VCP 11 the highest valid number is 14. The adaptable parameter **ELEV** being set to 1 points to the 0.5 degree elevation. Once a combined shear field is generated, the Combined Shear Contour product may be generated. The adaptable parameter **CI** controls the contour interval and is expressed as an integer multiple of 0.001 s^{-1}. Note that the Combined Shear Product's legend displays the shear categories as 10 times the integer times 10^{-4} s^{-1}.

Changing the adaptable parameters **DOR** and **NFL** affects the magnitude of the shear displayed, the granularity and resolution of the data, and processing load on the RPG. The algorithm computes the average of all radial and tangential shears in their respective Cartesian grids. Increasing the value of **DOR** increases the number of shear values that are averaged together, which effectively lowers the maximum value of shears that will be displayed. Conversely, decreasing **DOR** will cause fewer shear values to be mapped to any particular grid location. With fewer values averaged together, greater extremes will be displayed. At 0.5 km resolution there is not enough resolution in the radial data to map a shear value to each Cartesian grid point. This results in a grainy appearance in the product. However, increasing **DOR** to 4 km may coarsen the product sufficiently to mask significant shear-producing features. The adaptable parameter **NFL**, by filtering the data further, reduces peak shear values. It will also "smear" data into empty grid points that are neighboring grid points with shear. Note: a value of 1 for NFL does no filtering and a value of 25 does the most smoothing.

Because the overall domain remains fixed at 232 x 232 km, increasing the resolution from 4 km to 0.5 km increases the number of bins in the Cartesian grid by a factor of 64, and thus increases the amount of processing that must be performed by the RPG. Changing the **NFL** from 1 to 25 further significantly increases the processing load.

```
                                  COMBINED SHEAR                    PAGE  1 OF  1
COMMAND: AD,*****,M,*****,CO,
FEEDBACK:                                                            OPER A/

         (M)odify   (E)nd   (C)ancel

ITEM          DOR    MSR    NFL    NSV    NTH    THCS    ELEV     CI

-----------------------------------------------------------------------
CURRENT       1.0    660      9      3    .75    2.0        1      2
-----------------------------------------------------------------------
MIN           0.5    650      1      3    .01    0.0        1      1
MAX           4.0    660     25      5    .99    5.0       20      5

Abbr  Description                 Units  Abbr  Description              Units
DOR - Grid Res(.5, 1, 2, or 4)     Km    THCS- Threshold Combined Shear
MSR - Max# Sample Vols per Radial  -           considered Non-zero      E10-3/S
NFL - #Pts in Filter(1, 9, or 25)  -     ELEV- Elev Cut# for running Alg.   -
NSV - #Vols in Vel Avg(3 OR 5)     -     CI  - Com. Shear Cont. Interval E10-3/S
NTH - Ratio of #Good to #Possible
      Shear Values per Grid Box    -
```

Figure 6.4-1

6.5 Hail

The Hail Detection Algorithm provides for each storm cell the following three estimates:

* the Probability of Hail (POH) of any size,

* the Probability of Severe Hail (POSH) (or hail ≥ ¾” in diameter), and

* the Maximum Expected Hail Size (MEHS).

Based on drop-size/hailstone distribution and empirical studies, the algorithm assumes that large reflectivity values observed aloft (above the freezing level (Ø°C)) are most likely hail. The algorithm’s inputs are environmental data and storm cells components’ maximum reflectivity and height above ground level (AGL). The environmental data is the height (MSL) of the Ø°C and -2Ø°C environmental temperatures (see 6.2.2 Hail Temperatures / Default Storm Motion). Hail estimates are only provided for storm cells identified within the **Maximum Hail Processing Range**; beyond that range hail estimates are labeled ‘UNKNOWN’.

To determine the POH of any size for each storm cell, the height of the highest component with a maximum reflectivity value of at least **Thresh Min Reflectivity POH**, which is above the freezing level, is used in an empirical relationship. The higher the component is above the freezing level, the greater the POH. The increasing heights correlate to probabilities through the **POH Height Difference** parameters.

To determine the POSH and MEHS for each storm cell, the algorithm uses a relationship between reflectivity and the Hailfall Kinetic Energy (HKE), the flux of kinetic energy of hailstones. HKE is calculated from components with maximum reflectivity values (of at least **Thr HKE Ref Wgt Lower Lim**) above the freezing level using an equation with the **HKE Coefficients**. The computation is weighted toward those components with a maximum reflectivity of at least **Thr HKE Ref Wgt Upper Lim**. A vertical integration of the HKE is done for all components within a storm cell (which meet the relative height and reflectivity criteria), resulting in a parameter called the Severe Hail

Index (SHI). The integration is weighted toward those components above the height of the -2Ø°C environmental temperature. The greater the collective depth of components in a storm cell with large HKE values and the higher those components are above the freezing level, the larger a storm cell's SHI value. The MEHS for each storm cell is computed using SHI in an empirical formula with the **SHI Hail Size Coefficient** and **SHI Hail Size Exponent**. The POSH is calculated from SHI, the **POSH Coefficient**, the **POSH Offset**, and a warning threshold which is a function of the height of the freezing level, the **Warn Thresh Select Model Coefficient**, and the **Warn Thresh Select Model Offset**.

For the RCM product, the POSH is converted to a Hail Index using the **Threshold (RCM Probable Hail)** and **Threshold (RCM Positive Hail)** parameters.

```
                                 HAIL DETECTION                   PAGE  1 OF  2
COMMAND: AD,*****,M,*****,HA,
FEEDBACK:                                                          OPER A/

(M)odify   (E)nd   (C)ancel

DESCRIPTION                            RANGE          VALUE         UNITS
________________________________________________________________________________
THR HKE REF WGT LOWER LIM             20 - 60          40           DBZ
THR HKE REF WGT UPPER LIM             30 - 70          50           DBZ
THRESH MIN REFLECTIVITY POH           30 - 60          45           DBZ
HKE COEFFICIENT # 1         0.0000000001 - 1.0      0.000500000     -
HKE COEFFICIENT # 2                0.005 - 0.5      0.084           -
HKE COEFFICIENT # 3                  1.0 - 100.0     10.0           -
POSH COEFFICIENT                     1.0 - 100.0     29.0           -
POSH OFFSET                            1 - 100         50           %
MAXIMUM HAIL PROCESSING RANGE        200 - 460        230           KM
SHI HAIL SIZE COEFFICIENT           0.01 - 1.0       0.10           -
SHI HAIL SIZE EXPONENT               0.1 - 1.0        0.5           -
WARN THRESH SELECT MODEL COEFFICIENT  0.0 - 500.0    57.5         100 J/M**2/S
WARN THRESH SELECT MODEL OFFSET    -500.0 - 500.0   -121.0        10**5 J/M/S
```

Figure 6.5-1

```
                                 HAIL DETECTION                   PAGE  2 OF  2
COMMAND: AD,*****,M,*****,HA,
FEEDBACK:                                                          OPER A/

(M)odify   (E)nd   (C)ancel

DESCRIPTION                            RANGE          VALUE         UNITS
________________________________________________________________________________
POH HEIGHT DIFFERENCE #1             0.0 - 20.0      1.625          KM
           DIFFERENCE #2             0.0 - 20.0      1.875          KM
           DIFFERENCE #3             0.0 - 20.0      2.125          KM
           DIFFERENCE #4             0.0 - 20.0      2.375          KM
           DIFFERENCE #5             0.0 - 20.0      2.625          KM
           DIFFERENCE #6             0.0 - 20.0      2.925          KM
           DIFFERENCE #7             0.0 - 20.0      3.300          KM
           DIFFERENCE #8             0.0 - 20.0      3.750          KM
           DIFFERENCE #9             0.0 - 20.0      4.500          KM
           DIFFERENCE #10            0.0 - 20.0      5.500          KM
THRESH (RCM PROBABLE HAIL)             0 - 100         30           %
THRESH (RCM POSITIVE HAIL)             0 - 100         50           %
```

Figure 6.5-2

6.6 Hydrometeorological Algorithms

The Hydrometeorological Algorithms menu is used to select one of the four Precipitation Processing Subsystem (PPS) menus.

```
                         HYDROMETEOROLOGICAL ALGORITHMS           PAGE  1 OF  1
COMMAND: AD,*****,M,*****,HY,
FEEDBACK:                                                          OPER A/

Select From Menu Items.

Algorithm Options:

(AC)cumulation Precipitation Algorithm
(AD)justment Precipitation Algorithm
(P)reprocessing Precipitation Algorithm
(R)ate Precipitation Algorithm
```

Figure 6.6-1

6.6.1 Accumulation Precipitation

The following menu lists the adaptable parameters for the Accumulation Precipitation algorithm. This algorithm uses rainfall rates for the current and previous volume scans to compute an accumulation over the time between the scans. Additionally, hourly accumulations are computed and a check for any missing periods is made.

```
                      ACCUMULATION PRECIPITATION ALGORITHM        PAGE  1 OF  1
COMMAND: AD,*****,M,*****,HY,AC,
FEEDBACK:                                                          OPER A/

         (M)odify   (E)nd   (C)ancel

ITEM        TIMRS    MXTIN    MNTIP    THRLI    ENGAG    MXPAC    MXHAC

-----------------------------------------------------------------------
CURRENT      60       30       54       400       0       400      800
-----------------------------------------------------------------------
MIN          45       15        0        50       0        50       50
MAX          60       60       60       800      59       400     1600

Abbr    Description                Units  Abbr    Description              Units
TIMRS - Elapsed Time to Restart    MIN    MXHAC - Max Hrly Accum. Allowed  MM
MXTIN - Max Time (Interpolation)   MIN
MNTIP - Min Time (In Hrly Period)  MIN
THRLI - Thresh (Hrly Outlier)      MM
ENGAG - End Time (Gage Accum)      MIN
MXPAC - Max Period Accum. Allowed  MM
```

Figure 6.6-2

6.6.2 Adjustment Precipitation

The Adjustment Precipitation algorithm uses rain gage reports to adjust the radar estimates. A radar estimate is assigned to each gage amount and the gage-radar pairs are used to compute a multiplicative bias. The bias is then applied to the WSR-88D rainfall estimates out to 124 nm.

```
                     ADJUSTMENT PRECIPITATION ALGORITHM           PAGE  1 OF  2
COMMAND: AD,*****,M,*****,HY,AD,
FEEDBACK:                                                          OPER A/

         (M)odify   (E)nd   (C)ancel

ITEM        TBIES    NSETS    RESBI    REMSQ    MXMSQ    THDIF

--------------------------------------------------------------
CURRENT     50        6       1.0      0.5      0.8      15
--------------------------------------------------------------
MIN         50        2       0.5      0.1      0.5       5
MAX         59       30       2.0      0.8      1.0      60

Abbr    Description                  Units
TBIES - Time (Bias Estimation)       MIN
NSETS - Thresh (Number of Sets)
RESBI - Reset (Bias)
REMSQ - Reset (Mean Square Error)
MXMSQ - Max (Mean Square Error)
THDIF - Thresh (Time Difference)     MIN
```

Figure 6.6-3

```
                     ADJUSTMENT PRECIPITATION ALGORITHM           PAGE  2 OF  2
COMMAND: AD,*****,M,*****,HY,AD,
FEEDBACK:                                                          OPER A/

         (M)odify   (E)nd   (C)ancel

ITEM        MXPRO    SYNOI    VADJF    GADSC    MXGAC    THGAC

--------------------------------------------------------------
CURRENT     12.0     0.05      0.5      2.0      400      0.6
--------------------------------------------------------------
MIN          6.0     0.01      0.0      0.5       25      0.1
MAX         48.0     0.50     10.0     10.0     1600     25.4

Abbr    Description                  Units
MXPRO - Time (Reset BIAS)            Hours
SYNOI - System Noise
VADJF - Variance (Adj. Factor)
GADSC - Thresh (Gage Discard)
MXGAC - Max Gage Accum. Allowed      MM
THGAC - Thresh (Gage Accum.)         MM
```

Figure 6.6-4

6.6.3 Preprocessing Precipitation

During the PPS Preprocessing, reflectivity data from the lowest four elevation angles are assembled into a ‘hybrid scan’ of reflectivity data. At near ranges, progressively higher elevations are used to ensure the reflectivity data is not contaminated with residual ground clutter. At farther ranges (beyond about 26 nautical miles), reflectivity data from either of the lowest two tilts may be used in the “hybrid scan”, depending on decisions made by the “bi-scan optimization” process. This process combines a Tilt Test to reduce contamination from anomalous propagation and a Bi-scan Maximization to ensure the highest reflectivity value from the two tilts is used in the precipitation estimate.

Depending on the height of freezing level, the Bi-scan Maximization may erroneously select unrepresentative reflectivity values from the ‘bright band’ at the second tilt. This will lead to increased areas of precipitation overestimates due to the ‘bright band’. To allow each radar site to mitigate the effect of the ‘bright band’, the URC has been designated the LOCA for the adaptable parameter that controls the minimum range where the Bi-scan Maximization is applied - **MNRBI.** Using the default values for **MNRBI** (180 kilometers) and **MXRBI** (230 kilometers), the Bi-scan Maximization will normally be performed at a range that is not contaminated by the ‘bright band’, however if a site determines that second tilt ‘bright band’ reflectivities are contaminating the precipitation estimates, they should increase the value of **MNRBI**. If a site believes that the most representative reflectivity values are at the second tilt at a nearer range, **MNRBI** should be decreased to include the region where they want the Bi-scan Maximization to be performed.

```
                     PREPROCESSING PRECIPITATION ALGORITHM        PAGE  1 OF  2
COMMAND: AD,*****,M,*****,HY,P,
FEEDBACK:                                                          OPER A/

         (M)odify   (E)nd   (C)ancel

ITEM        MNRFL    MXRFL    RFTLT    IRTLT    ORTLT    MNRBI    MXRBI

-----------------------------------------------------------------------
CURRENT     18.0     65.0      1.0      40      150      180      230
-----------------------------------------------------------------------
MIN        -30.0     50.0      0.0       0       40        0        0
MAX         30.0     70.0     20.0     150      230      230      230

Abbr    Description               Units  Abbr    Description         Units
MNRFL - Min Thresh (Refl.)        dBZ    MNRBI - Min Range (BI-Scan)  KM
MXRFL - Max Thresh (Refl.)        dBZ    MXRBI - Max Range (BI-Scan)  KM
RFTLT - Refl. (Tilt Test)         dBZ
IRTLT - Inner Range (Tilt Test)   KM
ORTLT - Outer Range (Tilt Test)   KM
```

Figure 6.6-5

The PPS Tilt Test was designed to reduce clutter and anomalous propagation contamination in precipitation estimates by ignoring the lowest tilt reflectivity data when the Tilt Test considers the data are contaminated. The adaptable parameter MXPCT (OSF LOCA) defines the maximum threshold decrease in the area of reflectivity data between the first and second tilts, which indicates the presence of widespread anomalous propagation. The default value for MXPCT (75%) should generate the most representative precipitation estimates at most sites, particularly if clutter filtering is properly applied. However, field experience and OSF and OH investigations have shown that the Tilt Test may occasionally misinterpret actual rainfall events as anomalous propagation (thereby reducing the area and quantity of radar rainfall estimates) and, at times, the Tilt Test may include excessive areas of anomalous propagation in the precipitation estimates. If a site notes significant problems that they believe to be caused by the Tilt Test, it may request an Urgent Change to an OSF-Controlled Adaptation Value as explained in section 1.4.1.

```
                     PREPROCESSING PRECIPITATION ALGORITHM         PAGE  2 OF  2
COMMAND: AD,*****,M,*****,HY,P,
FEEDBACK:                                                           OPER A/

         (M)odify   (E)nd   (C)ancel

ITEM        MNECH    MNRAA    MXPCT    MNDBZ    MXDBZ

-----------------------------------------------------------------------
CURRENT      600     10.0       75       0.0    65.0
-----------------------------------------------------------------------
MIN          100      0.0        0     -32.0    50.0
MAX         3000     20.0      100      20.0    90.0

Abbr    Description              Units  Abbr    Description          Units
MNECH - Min Area (Echo)          KM**2
MNRAA - Min Refl. (Area Avgd)    dBZ
MXPCT - Max Area (% Reduction)   %
MNDBZ - Min dBZ Processed        dBZ
MXDBZ - Max dBZ Processed        dBZ
```

Figure 6.6-6

6.6.4 Rate Precipitation

The adaptable parameter **MXPRA** defines the maximum instantaneous precipitation rate (in mm/hr) that the PPS uses to estimate rainfall. At the default WSR-88D Z-R relationship ($Z=300 \times R^{1.4}$), the default value of MXPRA (103.8 mm/hr) is equivalent to a reflectivity value of 53 dBZ. MXPRA can be used to mitigate the overestimation of precipitation caused by the high reflectivities associated with hail. If a site notes small regions of significant precipitation overestimation or underestimation that they believe are caused by an improper value for MXPRA, it may request an Urgent Change to this OSF-Controlled adaptation parameter value (see section 1.5.1).

Research, at several facilities including the OSF and the NWS Office of Hydrology, continues into determining the proper values for **MXPRA.** Establishing the proper value is complicated because there is no clearly defined value which separates rain from hail, because hail and rain frequently occur in the same radar bin, and because climatological maximum rainfall rates can be highly variable. The OSF recommends that the value for **MXPRA** be set within the range defined in the following Table 6.6 - 1:

Table 6.6 - 1: Rain Fall Rate vs: Equivalent Reflectivity

Rainfall Rate	Equivalent Reflectivity ($Z=300\times R^{1.4}$)
63.4 mm/hr (2.5 in/hr)	50 dBZ
74.7 mm/hr (2.9 in/hr)	51 dBZ
88.1 mm/hr (3.5 in/hr)	52 dBZ
103.8 mm/hr (4.1 in/hr)	53 dBZ
122.4 mm/hr (4.8 in/hr)	54 dBZ
144.3 mm/hr (5.7 in/hr)	55 dBZ

Generally, the value of MXPRA should be higher in a deep moist airmass than a dry shallow airmass. The highest values for MXPRA should be used in southern latitudes in the summer, and the lowest values should be used in northern latitudes in the spring. Changing the value of MXPRA within these limits will affect only small areas of rainfall in the cores of thunderstorms, however the value of MXPRA can significantly affect the rainfall estimates in those areas. Since the value of MXPRA is used as an upper limit by the PPS, no reflectivity values less than MXPRA will be affected.

It is important to note that prior to Build 9.0, the MXRFL (Maximum Reflectivity) and MXDBZ (Maximum dBZ) adaptable parameters in the PPS Preprocessing algorithm controlled the “hail cap”, i.e., the maximum reflectivity that the PPS will allow to be converted to rainfall. Now the MXPRA parameter (in units of rainrate, i.e., mm/hr) exclusively controls this hail cap.

```
                          RATE PRECIPITATION ALGORITHM             PAGE  1 OF  2
COMMAND: AD,*****,M,*****,HY,R,
FEEDBACK:                                                           OPER A/

         (M)odify   (E)nd   (C)ancel

ITEM        MXSPD    MXTDF    MNART    PTIM1    PTIM2    MXRCH

---------------------------------------------------------------
CURRENT     25       15.0      200     24.0     13.2     200
---------------------------------------------------------------
MIN         10       10.0       50      0.1      0.1      20
MAX         40       30.0     1000     99.9     99.9     700

Abbr    Description                  Units
MXSPD - Max Speed (Storm)            M/S
MXTDF - Thresh (Max Time Dif)        MIN
MNART - Min Area (Time Contin.)      KM**2
PTIM1 - Param (Time Contin. #1)      1/HR
PTIM2 - Param (Time Contin. #2)      1/HR
MXRCH - Max Rate (Echo Area Chng)    KM**2/HR
```

Figure 6.6-7

```
                          RATE PRECIPITATION ALGORITHM             PAGE  2 OF  2
COMMAND: AD,*****,M,*****,HY,R,
FEEDBACK:                                                           OPER A/

         (M)odify   (E)nd   (C)ancel

ITEM        RNCUT    COER1    COER2    COER3    MNPRA    MXPRA

----------------------------------------------------------------
CURRENT     230      0.0       1.0     0.0       0.0      103.8
----------------------------------------------------------------
MIN           0      0.0       1.0     0.0       0.0       50.0
MAX         230      3.0      10.0     1.0      10.0     1600.0

Abbr    Description                 Units
RNCUT - Range (Cut-off)             KM
COER1 - Coef. (Range Effect #1)     dBR
COER2 - Coef. (Range Effect #2)
COER3 - Coef. (Range Effect #3)     dBR
MNPRA - Min Precip Rate Processed   MM/HR
MXPRA - Max Precip Rate Allowed     MM/HR
```

Figure 6.6-8

6.7 Mesocyclone - Delegated URC Authority

The OSF has authorized field personnel to change the TPV adaptable parameter in the Mesocyclone Algorithm.

6.7.1 Delegated Authority Restrictions

The default value of TPV is set at 10. Sites may change the value of TPV from 10 to lower values, but not lower than 6.

6.7.2 Supplemental Information

When ***NON-TRADITIONAL*** supercell mesocyclones are forecast or observed, UCP operators should consider reducing the Mesocyclone Algorithm adaptable parameter TPV. (TPV defines the minimum number of pattern vectors contained in a 2D feature.) At smaller values of TPV, the Mesocyclone Algorithm should produce more detections on smaller features. However, this change may also generate more false alarms. If the change has a detrimental effect on the mesocyclone algorithm's performance, return the adaptable parameter setting to its original value of 10.

6.7.3 Additional Reference Material

For additional information refer to the following papers:

A Study of Mini Supercells Observed by WSR-88D Radars, R. L. Lee, et al, 1995, and

Improvement of the Mesocylone Algorithm, R. L. Lee, 1996

.

```
                                   MESOCYCLONE                           PAGE  1 OF  2
COMMAND: AD,*****,M,*****,M,
FEEDBACK:                                                                 OPER A/

      (M)odify  (E)nd  (C)ancel

ITEM       TFR   TRF    TFH     THM   THS    TLM   TLS   TMR   TMA   TRM

--------------------------------------------------------------------------------
CURRENT    4.0   1.6    8.0   540.0  14.4  180.0   7.2   2.0   1.9   0.5
--------------------------------------------------------------------------------
MIN        0.1   0.1    4.0   180.0   7.2   90.0   3.6   0.1   0.5   0.1
MAX       10.1  10.1   10.1  1080.0  28.8  540.0  14.4  10.0  10.0  10.0

Abbr Description               UNITS   Abbr Description             UNITS
TFR - Th(Far Max Ratio)                TLM - Th(Low Momentum)       Km2/Hr
TRF - TH(Far Min Ratio)                TLS - Th(Low Shear)           1/Hr
TFH - Th(Feature Height)        Km     TMR - Th(Max Ratio)
THM - Th(High Momentum)        Km2/Hr  TMA - Th(Meso Azimuth)        deg
THS - Th(High Shear)            1/Hr   TRM - Th(Min Ratio)
```

Figure 6.7-1

```
                                   MESOCYCLONE                           PAGE  2 OF  2
COMMAND: AD,*****,M,*****,M,
FEEDBACK:                                                                 OPER A/

      (M)odify  (E)nd  (C)ancel

ITEM       TPV   TRD    TRA     MXF   MXM

--------------------------------------------------------------------------------
CURRENT     10  0.75  140.0     650    20
--------------------------------------------------------------------------------
MIN          1  0.25    0.0       1     1
MAX         20  5.00  230.0     650    20

Abbr Description               UNITS
TPV - Th(Pattern Vector)
TRD - TH(Radial Distance)       Km
TRA - Th(Range)                 Km
MXF - Max # Features
MXM - Max # Meso
```

Figure 6.7-2

6.8 Precipitation Detection

The Precipitation Detection Function (PDF) is designed to automatically determine if precipitation is occurring within 124 nm of the radar. The PDF examines reflectivity returns from the four lowest elevation angles, and compares them to the Precipitation Rate Threshold and an Area Threshold, which is the sum of the Precipitation Area Threshold and the Nominal Clutter Area Threshold. One of the following three Precipitation Categories is assigned each volume scan depending on which combination of thresholds are met or exceeded:

Category 0 - No precipitation detected.

Category 1 - Significant precipitation detected.

Category 2 - Light precipitation detected.

When Precipitation Category 1 has not been detected during the past hour, any VCP can be selected. When the assigned Precipitation Category is 1, the radar can only be operated in a Precipitation Mode (VCP 11 or 21).

When the assigned Precipitation Category is 1 or 2, the PPS computes rainfall accumulations and rain gage data is requested from the Gage Data Support System (GDSS). When the assigned Precipitation Category is 0, “null’ (zero-valued) rainfall products are generated and no gage data is requested from the GDSS.

6.8.1 Nominal Clutter Area - URC LOCA

Each line of the PDF menu is defined by a Tilt Domain (elevation angle range), a Precipitation Rate Threshold, the Nominal Clutter Area and Precipitation Area Thresholds, and the resulting Precipitation Category.

```
                            PRECIPITATION DETECTION                PAGE  1 OF  1
COMMAND: AD,*****,M,*****,P,
FEEDBACK:                                                           OPER A/

      (M)odify, {LINE#}   (E)nd     (C)ancel   (D)elete, {LINE#}

                       Precip     Nominal     Precip
                        Rate      Clutter      Area
           Tilt        Thresh      Area       Thresh       Precip
 N        Domain        (dBR)      (Km2)       (Km2)         Cat.
------------------------------------------------------------------
             -
------------------------------------------------------------------
 1       0.0    2.0     -2.0         80          20           2
 2       0.0    4.0      4.0        150          10           1
 3       2.0    4.0     -2.0         80          20           2
```

Figure 6.8-1

The Nominal Clutter Area (NCA) is the ***only*** adaptable parameter on the Precipitation Detection screen that may be changed under URC level of change authority. All others are under OSF level of change authority. The NCA allows the operator a way to account for residual clutter. By setting the NCA for both categories 1 and 2 equal to or slightly larger than the area of residual clutter, which is typically observed on days with no rainfall-producing echoes or anomalous propagation, you will prevent the radar from going into Precipitation Mode due to the presence of non-meteorological echoes. The NCA should be regularly monitored and set so that Precipitation Categories 1 and 2 are assigned by the PDF when real precipitation is occurring anywhere within range of the radar. In order to correctly set the NCA, the detected area of reflectivity returns can be checked on the Precipitation Status screen (ST,PRE).

The NCA value ***only*** affects the minimum areal threshold for assigning Precipitation Categories. If not correctly set, the NCA may allow for the accumulation of non-precipitation returns, but has ***no*** impact on the quality of other radar data. Thus, every effort should be made to filter normal and abnormal ground clutter at the RDA.

The PDF computes the areal coverage of return from all the reflectivities above the Rate Threshold values. The PDF does not discern between a ground return and a real precipitation target. In events where the PDF assigns a precipitation category incorrectly due to ground returns, the UCP operator should first attempt to reduce the ground returns using clutter suppression, and then account for any residual clutter with the NCA Threshold. The NCA is only a threshold value, and has no affect on the base data.

The NCA should ***NOT*** generally be used to prevent the radar from switching into Precipitation Mode A due to the presence of anomalous propagation echoes. To prevent the radar from switching into Mode A when transient anomalous propagation echoes are the only echoes present, it is recommended that you judiciously use operator-defined clutter suppression regions (Section 3.4.5) during the time when the anomalous propagation conditions are occurring. This will improve the quality of the base data products and consequently the derived products as well. Increasing the NCA in anomalous propagation situations will not improve the quality of the base data since the anomalous propagation echoes will still remain in the products.

It is especially important to note that if operator-defined clutter suppression regions cannot properly remove all of the anomalous propagation contamination and therefore the decision is made to increase the NCA to prevent the radar from switching into Precipitation Mode A, then you should only increase the value of NCA for Precipitation Category 1 (line 2 in the table in Fig. 6.8-1). It is Precipitation Category 1 in the Precipitation Detection Function which controls what mode the radar operates in. If and when the NCA is increased to prevent the radar from switching into Precipitation Mode A because of the existence of anomalous propagation, the NCA must be promptly returned to the proper smaller value characteristic of residual clutter to permit the radar to operate properly and switch into Precipitation Mode when real rainfall begins.

You should never increase the values of NCA for the “light precipitation” Category 2 (lines 1 and 3 in Fig. 6.8-1) since Precipitation Category 2 controls if and when the precipitation algorithms run. The values of NCA for Category 2 should always remain at values which are slightly larger than the area of residual clutter on days with no rain- producing echoes.

In the event of anomalous propagation with NCA for Category 2 set to proper low values, the precipitation algorithms will execute as expected and automatically remove the negative effects of anomalous propagation on the precipitation estimates through quality control logic internal to the algorithms. The danger in indiscriminately increasing the NCA for Precipitation Category 2 is that the precipitation algorithms may not execute when in fact it is raining. This may occur, for example, when a rain event is developing and the radar operator forgets that the Category 2 values had been increased. This will result in the unrecoverable loss of rainfall accumulation for that period. Note that this would be a more serious effect than had that person used operator-defined clutter suppression regions to remove anomalous propagation and forgotten to delete them after the AP conditions abated since only those areas with zero radial velocity would be improperly underestimated. ***It is important that the rain-***

fall algorithms execute even when the lightest rain is occurring in order to preserve water volume for the hydrologic models.

6.8.2 Supplemental Information - Mode B and Very Light Precipitation

At times, precipitation accumulations may be desired while the radar is operating in a Clear Air Mode VCP. This is appropriate for very light rain or snow events. In this case, it is permissible under URC guidelines, to raise the NCA threshold value for Category 1 precipitation, but leave it set relatively low for Category 2 precipitation. If this is done, the Precipitation Rate and Area thresholds will be exceeded for Category 2, but will not be exceeded for Category 1. Any VCP can be invoked, and precipitation products will accumulate rainfall estimates.

The Precipitation Status Screen (ST,PRE) provides the results from the Precipitation Detection Function for each volume scan. Types of data include the currently assigned precipitation category and the time left until the operator may select a Clear Air Mode VCP. Additionally, the detected area of reflectivity returns above the precipitation rate threshold can be used to correctly adjust the NCA.

6.9 Storm Cell Segments

This algorithm identifies radial sequences of reflectivity, or segments, as part of the processing to identify storm cells. These segments are runs of contiguous range bins with reflectivity values greater than or equal to a specified **Threshold (Reflectivity)** and have a combined length greater than a specified **Threshold (Segment Length)**. Also, a segment may contain up to a **Threshold (Dropout Count)** number of contiguous range bins which are within **Threshold (Dropout Ref Diff)** below the reflectivity threshold. The range of allowable values for these adaptable parameters are such that the parameters can be set low enough to identify and track snow showers.

The algorithm has seven **Reflectivity Thresholds** (and a minimum segment length threshold for each reflectivity threshold). The algorithm searches for segments within the **Threshold (Max Segment Range)**. As a processing limitation, there is a maximum number of segments per radial (for each reflectivity threshold) and per elevation scan, **Max # of Segments/Radial** and **Max # of Segments/Elev**, respectively.

For each segment, the following attributes are calculated and saved: maximum reflectivity, mass-weighted length, and mass-weighted length squared. The maximum reflectivity is a running average of the reflectivity values in **Reflectivity Avg Factor** bins. To calculate the mass-weighted length and the mass-weighted length squared, the **Mass Weighted Factor**, **Mass Multiplicative Factor**, and **Mass Coefficient Factor** are used.

```
                              STORM CELL SEGMENTS                  PAGE  1 OF  2
COMMAND: AD,*****,M,*****,SE,
FEEDBACK:                                                           OPER A/

(M)odify (E)nd (C)ancel

DESCRIPTION                             RANGE               VALUES    UNITS
-------------------------------------------------------------------------------
THRESH (REFLECTIVITY #1)                 0 - 80                60     DBZ
       (REFLECTIVITY #2)                 0 - 80                55     DBZ
       (REFLECTIVITY #3)                 0 - 80                50     DBZ
       (REFLECTIVITY #4)                 0 - 80                45     DBZ
       (REFLECTIVITY #5)                 0 - 80                40     DBZ
       (REFLECTIVITY #6)                 0 - 80                35     DBZ
       (REFLECTIVITY #7)                 0 - 80                30     DBZ
THRESH (SEGMENT LENGTH #1)             1.0 - 5.0              1.9     KM
       (SEGMENT LENGTH #2)             1.0 - 5.0              1.9     KM
       (SEGMENT LENGTH #3)             1.0 - 5.0              1.9     KM
       (SEGMENT LENGTH #4)             1.0 - 5.0              1.9     KM
       (SEGMENT LENGTH #5)             1.0 - 5.0              1.9     KM
```

Figure 6.9-1

```
                              STORM CELL SEGMENTS                  PAGE  2 OF  2
COMMAND: AD,*****,M,*****,SE,
FEEDBACK:                                                           OPER A/

(M)odify (E)nd (C)ancel

DESCRIPTION                             RANGE               VALUES    UNITS
-------------------------------------------------------------------------------
THRESH (SEGMENT LENGTH #6)             1.0 - 5.0              1.9     KM
       (SEGMENT LENGTH #7)             1.0 - 5.0              1.9     KM
THRESH (DROPOUT REF DIFF)                0 - 10                 5     DBZ
THRESH (DROPOUT COUNT)                   0 - 5                  2     -
NBR REFLECTIVITY LEVELS                  1 - 7                  7     -
THRESH (MAX SEGMENT RANGE)             230 - 460              460     KM
MAX # OF SEGMENTS/RADIAL                10 - 50                15     -
MAX # OF SEGMENTS/ELEV                4000 - 6000            6000     -
REFLECTIVITY AVG FACTOR                  1 - 5                  3     -
MASS WEIGHTED FACTOR               50000.0 - 60000.0      53000.0   HR/KG/KM**4
MASS MULTIPLICATIVE FACTOR           450.0 - 550.0          486.0     -
MASS COEFFICIENT FACTOR               1.20 - 1.50            1.37     -
```

Figure 6.9-2

6.10 Velocity Dealiasing

The adaptable parameters for the velocity dealiasing algorithm are adjusted using the following menus.

6.10.1 Short Pulse

These parameters are used when operating in VCPs 11, 21, and 32.

```
                      SHORT PULSE VELOCITY DEALIASING              PAGE  1 OF  3
COMMAND: AD,*****,M,*****,VE,S,
FEEDBACK:                                                           OPER A/

         (M)odify  (E)nd  (C)ancel

ITEM        NRLA   NRLB   NLB    NLF    NBF    TDU      TSSD

------------------------------------------------------------------------------
CURRENT      10      4     30     15      5   10.00    0.40
------------------------------------------------------------------------------
MIN           5      4      5     10      5    1.00    0.00
MAX          20     10     45     20     10   15.00    1.00

Abbr  Description               Units    Abbr   Description              Units
NRLA - Num Replace (Look Ahead)          TDU  - Threshold (Diff Unfold)   M/S
NRLB - Num Replace (Look Back)           TSSD - Thresh (Scale Std. Dev.)
NLB  - Number (Look Back)
NLF  - Number (Look Forward)
NBF  - Number (Radial)
```

Figure 6.10-1

```
                      SHORT PULSE VELOCITY DEALIASING              PAGE  2 OF  3
COMMAND: AD,*****,M,*****,VE,S,
FEEDBACK:                                                           OPER A/

         (M)odify  (E)nd  (C)ancel

ITEM        TCBR   TMM    NRPA   NRCA   TMBJ   TJR      TJA

------------------------------------------------------------------------------
CURRENT       5     30     10     30     75    0.75    0.60
------------------------------------------------------------------------------
MIN           1     10      5     15     10    0.50    0.50
MAX          10     50     20     50    100    1.00    1.00

Abbr  Description               Units    Abbr   Description              Units
TCBR - Thresh (Consec Reject)            TJR  - Thresh (Vel Jump Fact)
TMM  - Threshold (Max Missing)           TJA  - Thresh (Az Diff Fact)
NRPA - Num (Reunfold Prev Az)
NRCA - Num (Reunfold Curr Az)
TMBJ - Thresh (Max Bins Jump)
```

Figure 6.10-2

```
                      SHORT PULSE VELOCITY DEALIASING              PAGE  3 OF  3
COMMAND: AD,*****,M,*****,VE,S,
FEEDBACK:                                                           OPER A/

         (M)odify  (E)nd  (C)ancel

ITEM        TMCJ   TBLA   EST    USF    TSDU

------------------------------------------------------------------------------
CURRENT       5     10    720      1    1.50
------------------------------------------------------------------------------
MIN           1      3      1      0    1.00
MAX          10     12    999      1    2.00

Abbr  Description               Units    Abbr   Description              Units
TMCJ - Thresh (Max Cont Az Jump)         TSDU - Thresh (Scale Diff Unfld)
TBLA - Thresh (Num Az Jump)
EST  - Thresh (Sounding Age)     MIN
USF  - Flag (Sounding)
```

Figure 6.10-3

6.10.2 Long Pulse

These parameters are used when operating in VCP 31.

```
                      LONG PULSE VELOCITY DEALIASING               PAGE  1 OF  3
COMMAND: AD,*****,M,*****,VE,L,
FEEDBACK:                                                           OPER A/

         (M)odify  (E)nd  (C)ancel

ITEM        NRLA   NRLB   NLB    NLF    NBF    TDU      TSSD

------------------------------------------------------------------------------
CURRENT      10      4     30     15     10    3.00     0.80
------------------------------------------------------------------------------
MIN           5      4      5     10      5    1.00     0.00
MAX          20     10     45     20     10   15.00     1.00

Abbr  Description               Units    Abbr   Description              Units
NRLA - Num Replace (Look Ahead)          TDU  - Threshold (Diff Unfold)   M/S
NRLB - Num Replace (Look Back)           TSSD - Thresh (Scale Std. Dev.)
NLB  - Number (Look Back)
NLF  - Number (Look Forward)
NBF  - Number (Radial)
```

Figure 6.10-4

```
                      LONG PULSE VELOCITY DEALIASING              PAGE  2 OF  3
COMMAND: AD,*****,M,*****,VE,L,
FEEDBACK:                                                          OPER A/

         (M)odify  (E)nd  (C)ancel

ITEM        TCBR   TMM    NRPA   NRCA   TMBJ   TJR      TJA

------------------------------------------------------------------------------
CURRENT       5     30     10     30      40    0.75    0.60
------------------------------------------------------------------------------
MIN           1     10      5     15      10    0.50    0.50
MAX          10     50     20     50     100    1.00    1.00

Abbr  Description               Units    Abbr   Description              Units
TCBR - Thresh (Consec Reject)            TJR  - Thresh (Vel Jump Fact)
TMM  - Threshold (Max Missing)           TJA  - Thresh (Az Diff Fact)
NRPA - Num (Reunfold Prev Az)
NRCA - Num (Reunfold Curr Az)
TMBJ - Thresh (Max Bins Jump)
```

Figure 6.10-5

```
                      LONG PULSE VELOCITY DEALIASING              PAGE  3 OF  3
COMMAND: AD,*****,M,*****,VE,L,
FEEDBACK:                                                          OPER A/

         (M)odify  (E)nd  (C)ancel

ITEM        TMCJ   TBLA   EST    USF    TSDU

------------------------------------------------------------------------------
CURRENT       2     10    719      1    1.20
------------------------------------------------------------------------------
MIN           1      3      1      0    1.00
MAX          10     12    999      1    2.00

Abbr  Description               Units    Abbr   Description              Units
TMCJ - Thresh (Max Cont Az Jump)         TSDU - Thresh (Scale Diff Unfld)
TBLA - Thresh (Num Az Jump)
EST  - Thresh (Sounding Age)     MIN
USF  - Flag (Sounding)
```

Figure 6.10-6

6.10.3 Additional Reference Material

For additional information refer to the following paper:

Efficient Dealiasing of Doppler Velocities Using Local Environmental Constraints, Eilts and Smith, 1990.

6.11 Severe Weather Probability (SWP)

This menu allows changing the SWP coefficient parameters and the box size for which SWP values are calculated.

```
                                      SWP                          PAGE  1 OF  1
COMMAND: AD,*****,M,*****,SW,
FEEDBACK:                                                            OPER A/

      (M)odify  (E)nd  (C)ancel

ITEM        SBS    SW1      SW2      SW3      SW4      SW5      SW6

--------------------------------------------------------------------------------
CURRENT      28    5.820   -0.576   -0.964    0.000    0.046    0.000
--------------------------------------------------------------------------------
MIN          12  -99.999  -99.999  -99.999  -99.999  -99.999  -99.999
MAX         100   99.999   99.999   99.999   99.999   99.999   99.999

Definitions                Units          Definitions            Units
SBS - SWP Box Size            km          SW4 - SWP Coef 4           -
SW1 - SWP Coef 1               -          SW5 - SWP Coef 5           -
SW2 - SWP Coef 2               -          SW6 - SWP Coef 6           -
SW3 - SWP Coef 3               -
```

Figure 6.11-1

6.12 Storm Cell Tracking and Forecast

The Storm Cell Tracking and Storm Position Forecast algorithms, components of the Storm Cell Identification and Tracking (SCIT) algorithm suite, monitor and predict the movement of storm cells. Although the SCIT algorithm suite exhibits significant tracking and forecast skill, cell mergers/splits and rapid cell decay/growth may not be handled well.

The first step is matching storms found in the current volume scan to the storm cells from the previous volume scan in time and space. The second step is to forecast their movement.

The storm cells are matched as follows. Starting with the most intense cell (i.e. largest cell-based VIL value) in the current volume scan, the centroid position is compared to the projected centroid positions of cells from the previous volume scan. A cell's projected centroid position is its forecasted position for the current volume scan. The cell from the previous volume scan with a projected centroid located within a distance computed from the **Correlation Speed** which is closest to the current cell is correlated. When a cell is correlated, it is considered the same cell and assigned the same storm cell ID. Then, the next most intense cell in the current volume scan is compared to all uncorrelated cells in the previous volume scan, and so on, until all cells in the current volume scan are processed. Once a cell from the previous volume scan is correlated, it is not compared to any more cells in the current volume scan. If no projected centroid positions are within the adaptable range of a cell's centroid position, the cell remains uncorrelated and is assigned a new storm cell ID. If a time period of more than **Time (Maximum)** has passed between the current and past volume scans, then no matching is done, and all storms in the current volume scan are considered new. The centroid positions used are in a Cartesian coordinate system with the radar at the origin, and where the X-axis denotes east-west directions and the Y-axis denotes north-south directions.

The forecast of a storm cell's movement is based on the cell's movement over its lifetime, for up to the **Number of Past Volumes**, including the current volume scan. The first time a storm cell is detected it is labeled new. In this case, no prediction of movement is made, and the cell is assigned a vector average storm motion of all cells in the previous volume scan (or the default storm motion if no storm cells previously existed (see Section 6.2.2)). After the first volume scan a storm cell is detected, a forecast movement is computed based on a linear least squares extrapolation of its previous movement. Forecast positions are computed in time steps equal to the **Forecast Interval**. The number of forecast positions, or **Number of Intervals**, computed for a cell depends upon the scaled forecast error and the permissible error. The scaled forecast error is the accuracy of the previous volume scan's forecast (or forecast error) scaled by the ratio of the **Error Interval** over the time between volume scans. The permissible error is the **Allowable Error** scaled by the **Error Interval** over the length (in time) of the forecast (for this **Forecast Interval**). Basically, the poorer a forecast was for a cell for the past volume scan, the fewer the number of forecast positions. For display purposes only, if a storm cell's forecasted movement is less than the **Thresh (Minimum Speed)**, then no past and forecast positions are graphically displayed. In this case, the cell's movement is displayed as a centroid symbol with a concentric circle (at the current position).

```
                       STORM CELL TRACKING AND FORECAST            PAGE  1 OF  1
COMMAND: AD,*****,M,*****,TR,
FEEDBACK:                                                           OPER A/

(M)odify   (E)nd   (C)ancel

DESCRIPTION                             RANGE               VALUE    UNITS
--------------------------------------------------------------------------------
CORRELATION SPEED                    10.0 - 40.0            30.0     M/S
NUMBER OF PAST VOLUMES                  7 - 13                10     -
NUMBER OF INTERVALS                     1 - 4                  4     -
FORECAST INTERVAL                       5 - 30                15     MIN
ALLOWABLE ERROR                        10 - 60                20     KM
ERROR INTERVAL                          5 - 30                15     MIN
THRESH (MINIMUM SPEED)                0.0 - 10.0             2.5     M/S
TIME (MAXIMUM)                         10 - 60                20     MIN
```

Figure 6.12-1

6.13 Turbulence

This menu allows modification of the turbulence algorithm parameters.

```
                                                   TURBULENCE                              PAGE  1 OF  1
COMMAND: AD,*****,M,*****,TU,
FEEDBACK:                                                                                    OPER A/

      (M)odify  (E)nd  (C)ancel

ITEM               KOL   TOS

-------------------------------
CURRENT            1.35   2.0
-------------------------------
MIN                0.01   0.1
MAX               99.99  20.0



Definitions                        Units
(KOL) - Kolmolgorov Constant           -
(TOS) - Turbulence (Outer Scale)      km
```

Figure 6.13-1

6.14 Tornadic Vortex Signature (TVS) - Delegated URC Authority

The OSF has authorized field personnel to change the TVS Shear Threshold (TTS) adaptable parameter in the Tornadic Vortex Signature Algorithm.

6.14.1 Delegated Authority Restrictions

URCs are authorized to adjust the TVS Shear Threshold (TTS) to a value ranging from the current default value of 72 hr-1 to a minimum of 18 hr-1.

```
                                                      TVS                                  PAGE  1 OF  1
COMMAND: AD,*****,M,*****,TV,
FEEDBACK:                                                                                    OPER A/

      (M)odify  (E)nd  (C)ancel


ITEM                 PCT      TTS

---------------------------------------------------------------------------
CURRENT              5.0       72.0
---------------------------------------------------------------------------
MIN                  0.0       18.0
MAX                 50.0     1800.0


Definitions                    Units
PCT - Search Percentage       Percent
TTS - Threshold (TVS Shear)    1/hr.
```

Figure 6.14-1

6.14.2 Supplemental Information

The OSF provides the following information and authorization for WSR-88D Unit Radar Committees (URCs) to change the TVS adaptable parameter Threshold TVS Shear (TTS). This parameter defines the minimum shear required for the TVS Algorithm to signal the presence of a tornadic circulation. In general, lowering TTS will increase the skill of the TVS Algorithm as measured by the Critical Success Index. Lowering TTS will increase the probability that weak or distant tornadoes will be detected; however, the algorithm will also generate more false alarms.

6.15 Velocity Azimuth Display (VAD)

Three adaptable parameters under the URC LOCA allow local modification of the VAD algorithm. The beginning azimuth (TBZ) and ending azimuth (TEZ) parameters enable the local site to define a partial circle from which to collect data. This allows the site to restrict data collection over areas where residual clutter may severely bias the velocity estimate (e.g., a ridge line, area of tall buildings, etc.,). The third parameter, VAD (analysis) range (VAD), defines the optimal slant range to collect velocity samples. This parameter should be modified to ensure adequate velocity samples are available for analysis. For example, on a cold, clear, dry day you may have to decrease the VAD (slant) range to enable the radar to collect enough samples to perform the VAD analysis. On the other hand, on a muggy, summer day you might increase the VAD (slant) range to negate the effects of residual ground clutter near the radar.

```
                                      VAD                            PAGE  1 OF  1
COMMAND: AD,*****,M,*****,VA,
FEEDBACK:                                                             OPER A/

     (M)odify  (E)nd  (C)ancel

ITEM                VAD    TBZ    TEZ    THV    THY   FT    NPTS

---------------------------------------------------------------------------
CURRENT             30.0    0.0    0.0   5.0    7.0    2      25
---------------------------------------------------------------------------
MIN                  1.0    0.0    0.0   0.0    0.0    1       1
MAX                230.0  359.9  359.9  15.0   20.0    5     360

Definition                           Units Definition                   Units
VAD - VAD Range                         km NPTS - Minimum number samples    -
TBZ - Threshold (Beginning Azimuth)   deg
TEZ - Threshold (Ending Azimuth)      deg
THV - Threshold (Velocity)            m/s
THY - Threshold (Symmetry)            m/s
FT  - Number of Fit Tests               -
```

Figure 6.15-1

6.16 Vertically Integrated Liquid Water (VIL)

This menu allows the VIL parameters to be modified.

```
                                      VIL                        PAGE  1 OF  1
COMMAND: AD,*****,M,*****,VI,
FEEDBACK:                                                         OPER A/

     (M)odify  (E)nd  (C)ancel

ITEM              BW    MRT   MVT

---------------------------------------------------------------------------
CURRENT          1.00   18.3   80
---------------------------------------------------------------------------
MIN              0.50  -33.0    1
MAX              2.00   94.0  200

Definition                    Units
BW  - Beam Width               deg
MRT - Min Ref Threshold        dBZ
MVT - Max VIL Threshold       Kg/m2
```

Figure 6.16-1

6.17 Z -R Coefficients - Delegated URC Authority

The Z-R Coefficients (**CZM** and **CZP**) define the relationship the PPS uses to convert from reflectivity to estimated rainfall rate as shown in the following equation:

$$\mathbf{Z = (CZM)} \times R^{(CZP)}$$

The default values for **CZM** (300) and **CZP** (1.4) are considered to be very representative in normal convective rain events.

6.17.1 Delegated Authority Restrictions

Our studies and numerous reports from the field have concluded that the default Z-R Coefficients may cause significant underestimation of precipitation in tropical, warm convective rain events, such as hurricanes and tropical storms. The OSF has authorized sites along the Gulf of Mexico and Atlantic Coasts to use a tropical Z-R relationship ($\mathbf{Z = 250R}^{(1.2)}$) during these tropical events.

6.17.2 Supplemental Information

To invoke the tropical Z-R relationship change the **CZM** to 250 and **CZP** to 1.2.

```
                                Z R COEFFICIENTS                  PAGE  1 OF  1
COMMAND: AD,*****,M,*****,Z,
FEEDBACK:                                                          OPER A/

     (M)odify  (E)nd  (C)ancel


ITEM           CZM    CZP

---------------------------
CURRENT        300    1.4
---------------------------
MIN             30    1.0
MAX           3000    2.5


Definition                            Units
CZM - Multiplicative Z-R  Coefficient  NA
CZP - Power Z-R Coefficient            NA
```

Figure 6.17-1